

CHAPTER V

CONCLUSION AND SUGGESTIONS

This chapter presents the conclusions and suggestions from the research that has been conducted. The conclusions summarize the research results based on the problem formulation and objectives established in Chapter I, covering the implementation of ResNet50 as a feature extractor on Google Street View images, the application of cosine similarity to measure the level of similarity between building images, redundant image elimination based on similarity threshold, and Google Maps API integration to obtain building location addresses automatically. The suggestions contain recommendations that can be considered for further research development based on the limitations found during the research process.

5.1 Conclusion

Based on the research results, testing, and analysis conducted regarding image similarity measurement using ResNet50 and street view analysis for residential location point identification in Bojonegoro Regency, the following conclusions can be drawn:

1. ResNet50 was successfully implemented as a feature extractor on Google Street View images with the configuration `include_top=False`, `weights='imagenet'`, and `pooling='avg'`. The ResNet50 model pre-trained on the ImageNet dataset is capable of extracting 2048-dimensional feature vectors from each building image without requiring retraining through a transfer learning approach. Testing showed that ResNet50 is capable of producing consistent feature representations on building images from various viewing angles and lighting conditions across the three sub-districts tested, namely Bojonegoro, Kapas, and Balen.
2. Cosine similarity was successfully applied to measure the level of similarity between building images based on the 2048-dimensional feature vectors produced by ResNet50. Cosine similarity testing results on image pairs from three sub-districts produced similarity values in the range of 0.83 to 0.94, indicating that the system is capable of accurately measuring the level of visual similarity between images. Cosine similarity has proven effective as

an image similarity measurement metric because it is not affected by differences in vector scale or magnitude, resulting in consistent measurements across various visual conditions of Google Street View images.

3. Redundant image elimination was successfully performed based on cosine similarity measurement results with a threshold of 0.95, selected through testing of four threshold value variations (0.85, 0.90, 0.95, and 0.98). The 0.95 threshold proved to provide the best balance by detecting 112 redundant images and producing only 2 elimination errors (False Positive Rate of 1.78%). The redundant elimination process successfully reduced the total dataset from 243 images to 131 representative images, equivalent to a 46.1% reduction from the initial number of images. The largest reduction occurred in Balen Sub-district at 48.8%, while Bojonegoro and Kapas sub-districts each experienced a reduction of 44.7%. Additionally, building classification testing using the Roboflow model on 30 samples from three sub-districts produced an accuracy of 100% with an average confidence value of 98.6%, proving that the system is capable of distinguishing residential and shop buildings with a very high level of certainty.
4. Google Maps API was successfully integrated to obtain address information based on the geographic coordinates of images through the reverse geocoding process. Testing on three representative coordinate points from Bojonegoro, Kapas, and Balen sub-districts showed that all reverse geocoding results received "Match" status, meaning that all address components produced by the API, including street name, village or sub-village, sub-district, regency, and province, matched the actual addresses in the field. This integration produced a building dataset that not only contains representative redundancy-free images, but is also equipped with accurate and complete spatial information. Thus, the developed system is capable of automating the building data collection process that was previously done manually, thereby saving costs, time, and effort in the regional asset management process in Bojonegoro Regency.

Thus, the image similarity measurement system using ResNet50 and street view analysis for residential location point identification has been proven to fulfill all

established research objectives. The developed system has been proven capable of automating the building data collection process that was previously done manually, making it worthy of being proposed as a regional asset management solution that is efficient, accurate, representative, and easy to implement by local government agencies and researchers in the field of computer vision. However, the system developed in this research still has several limitations, such as classification testing that was only conducted on 30 samples from three sub-districts and Google Maps API testing that was only verified on three representative coordinate points, so the generalization of results to wider areas with more diverse building characteristics still needs further testing. This becomes an opportunity for subsequent researchers to develop a system with wider area coverage, a larger number of test samples, and the addition of more diverse building classification categories to improve the overall accuracy and generalization of the system.

5.2 Suggestions

Based on the research results and research limitations that have been identified, there are several suggestions for further development in subsequent research.

1. It is recommended that the dataset used be expanded with image variations from various other regency or city areas in East Java, with more diverse weather conditions, lighting, and camera angles, to improve the model's generalization capability so that the system can be applied at a wider area scale.
2. A performance comparison between ResNet50 and other deep learning architectures such as EfficientNet, Vision Transformer (ViT), or ResNet101 needs to be conducted to determine the most optimal architecture for producing discriminative feature vectors in the building image similarity measurement task.
3. Building classification testing needs to be expanded by increasing the number of test samples and adding more diverse building categories, such as office buildings, schools, or public facilities, so that the system can be used for more comprehensive identification of various types of buildings.

4. Development of an interactive web GIS-based system interface is recommended so that building mapping results can be directly accessed and utilized by local government agencies or the general public for the purposes of asset management, spatial planning, and technology-based building monitoring programs.
5. For further research, integration with additional sensor data such as drone imagery, LiDAR, or high-resolution satellite imagery can be considered to enrich spatial data and improve the accuracy of building location identification, especially in areas not optimally covered by Google Street View services.